Improved Design of Radiation Hardened, Wide-Temperature Analog and Mixed-Signal Electronics, Phase II

Completed Technology Project (2011 - 2014)

Project Introduction

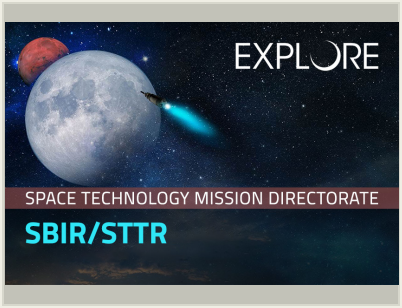
NASA space exploration missions require the electronics for avionic systems, components, and controllers that are capable of operating in the extreme temperature and radiation environments of space and planetary surfaces. To design wide-temperature, radiation-hardened (rad-hard) electronics and predict the characteristics and reliability in these extreme environments, advanced models and simulation tools are required at multiple levels. Analog and mixed-signal circuits for space exploration have not been adequately addressed to date. The proposed project aims to design, develop, validate, and demonstrate novel Radiation Hardened By Design (RHBD) analog/mixed-signal, RF and digital integrated circuits (ICs) aimed for application in NASA relevant extreme environments. In Phase 1, CFDRC, in collaboration with Georgia Tech, accomplished the following: (1) enhanced and demonstrated CFDRC's unique physics-based mixed-mode simulation tools (NanoTCAD coupled with Cadence Spectre) for predicting transient radiation response of benchmark analog circuits based on silicon-germanium (SiGe) BiCMOS technology; (2) leveraged experimental radiation/temperature data collected under the NASA Exploration Technology Development Program (ETDP) SiGe project to validate new low-T device physics models in NanoTCAD and understand associated physical phenomena; and (3) developed preliminary RHBD concepts for single-event hardening, including the novel inverse-mode cascode (IMC) SiGe HBT. In Phase 2, we will demonstrate and validate the improved physics-based models for temperature range from -230

o

C to +130

o

C, and apply them to evaluate and develop RHBD designs over the expected operating range. New RHBD devices employed in analog, RF and digital circuits will be fabricated in prototype chips and tested over a wide temperature range and in a radiation environment, and delivered as a component library for NASA use.



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Small Business Innovation Research/Small Business Tech Transfer

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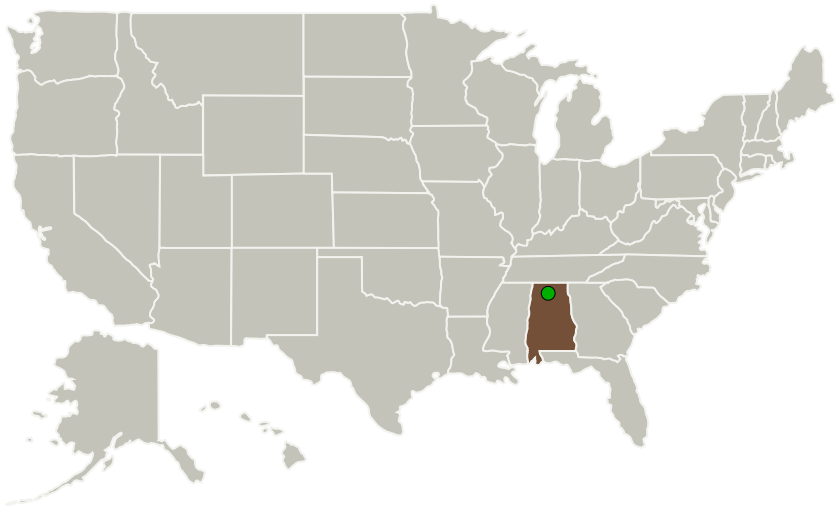
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations
Alabama

Project Transitions

June 2011: Project Start

August 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138971)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CFD Research Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

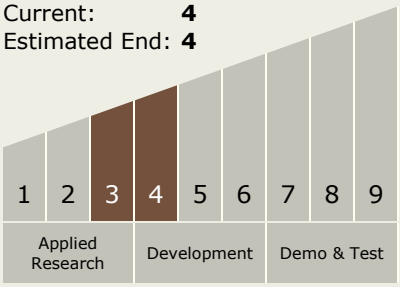
Carlos Torrez

Principal Investigator:

Ashok Raman

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX02 Flight Computing and Avionics
  - TX02.3 Avionics Tools, Models, and Analysis
    - TX02.3.2 Space Radiation Analysis and Modeling

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System